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Two-dimensional particle-in-cell simulation of hollow cathode discharges in the showerhead of capacitively coupled plasmas HEESUNG PARK, HAE JUNE LEE, Department of Electrical Computer Engineering, Pusan National University, Busan — The plasma property in a capacitively coupled deposition reactor with the hollow cathode (HC) showerhead has been investigated using a 2D PIC simulation with the variation of the hole size, the secondary electron emission (SEE) coefficient, the edge shape of the hole, and the applied DC bias. The SEE from the HC wall plays an important role in the increase of the plasma density, which is sensitive to the ratio of the hole size to the electron collisional mean free path. With the DC bias, the electron density shows different behaviors inside and outside of the HC. When the hole size is large enough, there are two electron density peaks in the HC and at the outer bulk plasma. The former is caused by the ionization enhanced by the SEE inside of the HC, and the latter is by the ionization near the substrate. Regardless of the hole size, the average electron density in the bulk plasma region increases with the positive DC bias while the negative DC bias decreases it. However, the electron density in the bulk HC region shows a complex mechanism, which is affected by the ionization rate as well as particle transport. Not only the ion Ohmic heating at the edge but also the electron Ohmic heating at the entrance of the hole are reduced with the reduced electric fields at the round edges.

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